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Bibliography.

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B60K 31/00 Z .
G01C 21/00 A .
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Summary.

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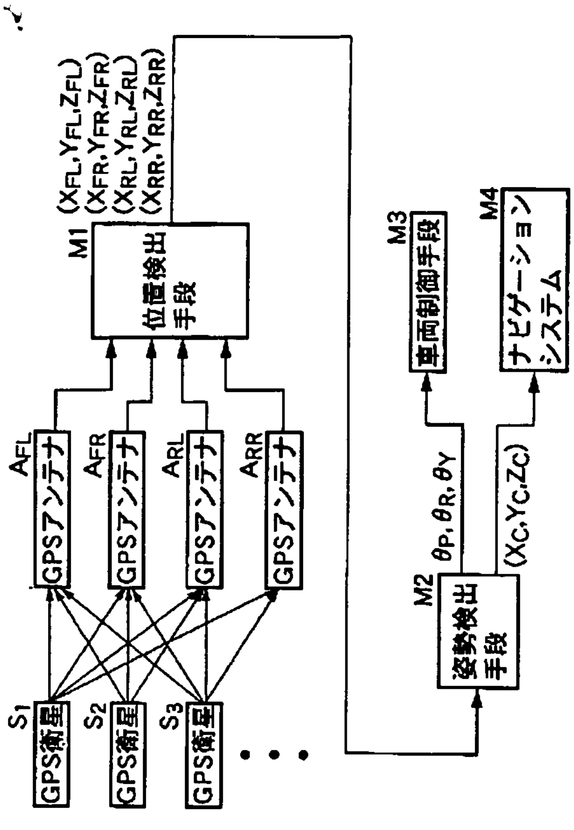
(57) [Abstract]
[Technical problem] K-GPS (kinematic global positioning system) or RTK-GPS (real-time kinematic global positioning system) is used, and it enables it to detect a vehicles posture correctly by receiving and processing the position data from a satellite with two or more receiving meanses.
[Means for Solution] The GPS antennas AFL, AFR, ARL, and ARR are formed near the suspension system of each wheel of a wagon, respectively, and it is the GPS satellite S1, S2, and S3. The position data from -- are received. Based on the aforementioned position data, the position of each GPS antennas AFL, AFR, ARL, and ARR is detected, the posture detection means M2 is based on the relative-position relation of each GPS antennas AFL, AFR, ARL, and ARR, and the position detection means M1 is helix-angle thetaP of vehicles, and roll angle thetaR. And yaw angle thetaY It detects.

[Translation done.]



[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] Posture detection equipment for vehicles characterized by providing the following. Two or more receiving meanses by which it is arranged at a time near [at least one] the anterior part suspension system of vehicles (V), and the posterior part suspension system, and each receives the position data from two or more satellites (S1, S2, S3 --) (AFL, AFR, ARL, ARR) A posture detection means detect the posture of vehicles (V) based on the position of a position detection means (M1) to detect the position of this receiving means (AFL, AFR, ARL, ARR) based on the position data received with each receiving means (AFL, AFR, ARL, ARR), and each receiving means (AFL, AFR, ARL, ARR) detected with the position detection means (M1) (M2)

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the posture detection equipment for vehicles which detects the posture of vehicles based on the position data obtained from a satellite.
[0002]
[Description of the Prior Art] GPS (global positioning system) which detects the position of vehicles based on the position data obtained from a satellite is widely used in the navigation equipment for vehicles. Since it is not avoided that an about dozens of m error occurs in the vehicles position detected by Above GPS, the detection precision of a vehicles position is raised by using an inertial navigation system together if needed.
[0003]
[Problem(s) to be Solved by the Invention] By the way, although it became possible to perform engine control, brake control, steering control, etc. still more finely when the vehicles posture (a helix angle, a roll angle, yaw angle) was correctly detectable, conventional GPS or a conventional inertial navigation system was not able to detect a vehicles posture, although detection of a vehicles position was possible.
[0004] this invention was made in view of the above-mentioned situation, and aims at enabling it to detect a vehicles posture correctly by receiving and processing the position data from a satellite with two or more receiving meanses.
[0005]
[Means for Solving the Problem] In order to attain the aforementioned purpose, invention indicated by the claim 1 Two or more receiving meanses by which it is arranged at a time near [at least one] the front part suspension system of vehicles, and the rear suspension system, and each receives the position data from two or more satellites, It is characterized by having a position detection means to detect the position of this receiving means based on the position data received with each receiving means, and a posture detection means to detect the posture of vehicles based on the position of each receiving means detected with the position detection means.
[0006] If the receiving means arranged at a time near [at least one] the front part suspension system of vehicles and the rear suspension system receives the position data from a satellite according to the above-mentioned composition, a position detection means will detect the position of each receiving means based on the aforementioned position data, and a posture detection means will detect the posture of vehicles based on the relative position of each aforementioned receiving means. Since the receiving means is arranged near [which was established in the four corners of vehicles] the suspension system, the relative deflection between two or more positions detected with each receiving means can be secured to the maximum, and a vehicles posture can be detected correctly.
[0007]
[Embodiments of the Invention] Hereafter, it explains based on the example of this invention which showed

the form of operation of this invention to the accompanying drawing.

[0008] Operation explanatory drawing in case operation explanatory drawing in case the block diagram in which drawing 1 - drawing 5 show one example of this invention, and drawing 1 shows the whole posture detection equipment composition for vehicles, drawing in which drawing 2 shows the attaching position of a GPS antenna, and drawing 3 detect the helix angle of vehicles, and drawing 4 detect the roll angle of vehicles, and drawing 5 are operation explanatory drawings in the case of detecting the yaw angle and vehicles position of vehicles.

[0009] As shown in drawing 1 , four GPS antennas AFL, AFR, ARL, and ARR which constitute the receiving means of this invention are carried in vehicles, and each GPS antennas AFL, AFR, ARL, and ARR are two or more GPS satellites S1, S2, and S3. The position data from -- are received. A position detection means M1 by which the signal received with each GPS antennas AFL, AFR, ARL, and ARR is inputted computes the position of each GPS antenna AFL, AFR, ARL, and ARR by the 3-dimensional absolute coordinate system (for example, WGS84) of X, Y, and Z. The GPS satellite S1, S2, and S3 The position detection error is suppressed by about several cm to -- and the GPS antennas AFL, AFR, ARL, and ARR and the position detection means M1 constituting K-GPS (kinematic global positioning system) or RTK-GPS (real-time kinematic global positioning system), and the position detection error of the conventional GPS being about dozens of m.

[0010] The position coordinate of each GPS antennas AFL, AFR, ARL, and ARR detected with the position detection means M1 is inputted into the posture detection means M2, and the posture detection means M2 detects the position of the center section of vehicles while computing the helix angle of vehicles, a roll angle, and a yaw angle based on the aforementioned position coordinate. The concrete technique is explained later. And while the helix angle of the vehicles detected in the posture detection means M2, a roll angle, and a yaw angle are inputted into the vehicles control means M3 and used for engine control, brake control, steering control, etc., the position of the vehicles detected in the posture detection means M2 is inputted into a navigation system M4, and is used for pinpointing of a vehicles position.

[0011] As shown in drawing 2 , Vehicles V are equipped with the front wheels WFL and WFR on either side and the rear wheels WRL and WRR on either side, and it is the near position of the suspension system of these wheels WFL, WFR, WRL, and WRR, and is the GPS satellite S1, S2, and S3. The aforementioned GPS antennas AFL, AFR, ARL, and ARR are formed in the position (for example, body of the right above of this suspension system) which can receive the signal from -- certainly, respectively. The GPS antennas AFL and ARL of a left-hand side order couple and the GPS antennas AFR and ARR of a right-hand side order couple are arranged to the body center line L at the bilateral symmetry.

[0012] In addition, in accordance with the direction of east and west, as for the 3-dimensional absolute coordinate system used by this example, the Z-axis of the X-axis shall correspond [the Y-axis] in the perpendicular direction in accordance with the direction of north and south.

[0013] Next, helix-angle thetaP of the vehicles V performed in the aforementioned posture detection means M2 Calculation is explained.

[0014] As shown in drawing 3 , it is helix-angle thetaP of Vehicles V. The position coordinate detected with the GPS antennas AFL and ARL of a left-hand side order couple is used for calculation. Namely, if the position coordinate of the forward left GPS antenna AFL is set to (XFL, YFL, ZFL) and the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL) Horizontal distance DP between both the GPS antennas AFL and ARL DP = {(XFL-XRL)2+(YFL-YRL) 2} It is given by one half and is the distance HP of the vertical direction between both the GPS antennas AFL and ARL. It is given by HP =ZFL-ZRL. Therefore, helix-angle thetaP of Vehicles V thetaP = tan-1 (H.P./DP)
It is alike and is computed more.

[0015] Instead of using the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple like the above-mentioned example, in addition, one position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior, One position coordinate of the GPS antennas ARL and

ARR of the right-and-left couple of a posterior may be used, and the average of the position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior and the average of the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior may be used. Moreover, when there is a difference in the mounting height of the GPS antennas AFL and AFR of an anterior, and the mounting height of the GPS antennas ARL and ARR of a posterior, according to the difference of the mounting height, there is amendment need about Z component of a position coordinate.
[0016] Next, roll angle thetaR of the vehicles V performed in the aforementioned posture detection means M2 Calculation is explained.
[0017] As shown in drawing 4 , it is roll angle thetaR of Vehicles V. The position coordinate detected with the GPS antennas ARL and ARR of the right-and-left couple of a posterior is used for calculation. Namely, if the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL) and the position coordinate of the right rear GPS antenna ARR is set to (XRR, YRR, ZRR) Horizontal distance DR between both the GPS antennas ARL and ARR DR = {(XRL-XRR)2+(YRL-YRR) 2} It is given by one half and is the distance HR of the vertical direction between both the GPS antennas ARL and ARR. It is given by HR =ZRL-ZRR. Therefore, roll angle thetaR of Vehicles V thetaR = tan-1 (HR/DR)
It is alike and is computed more.
[0018] Instead of using the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior like the above-mentioned example, in addition, one position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple, One position coordinate of the GPS antennas AFR and ARR of a right-hand side order couple may be used, and the average of the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple and the average of the position coordinate of the GPS antennas AFR and ARR of a right-hand side order couple may be used.
[0019] Next, yaw angle thetaY of the vehicles V performed in the aforementioned posture detection means M2 Calculation is explained.
[0020] As shown in drawing 5 , it is yaw angle thetaY of Vehicles V. The position coordinate detected with the GPS antennas AFL and ARL of a left-hand side order couple is used for calculation. That is, if the position coordinate of the forward left GPS antenna AFL is set to (XFL, YFL, ZFL) and the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL), the distance DY1 of the direction of east and west between both the GPS antennas AFL and ARL will be given by DY1=XFL-XRL, and the distance DY2 of the direction of north and south between both the GPS antennas AFL and ARL will be given by DY2=YFL-YRL. Therefore, yaw angle thetaY of the vehicles V on the basis of the direction of north thetaY = tan-1 (DY1/DY2)
It is alike and is computed more.
[0021] In addition, instead of using the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple like the above-mentioned example, the position coordinate of the GPS antennas AFR and ARR of a right-hand side order couple may be used, and the position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior and the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior may be used.

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to the posture detection equipment for vehicles which detects the posture of vehicles based on the position data obtained from a satellite.

[Translation done.]

PRIOR ART

[Description of the Prior Art] GPS (global positioning system) which detects the position of vehicles based on the position data obtained from a satellite is widely used in the navigation equipment for vehicles. Since it is not avoided that an about dozens of m error occurs in the vehicles position detected by Above GPS, the detection precision of a vehicles position is raised by using an inertial navigation system together if needed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] If the receiving means arranged at a time near [at least one] the front part suspension system of vehicles and the rear suspension system receives from a satellite to position data according to invention indicated by the claim 1 as mentioned above, a position detection means will detect the position of each receiving means based on the aforementioned position data, and a posture detection means will detect the posture of vehicles based on the relative position of each aforementioned receiving means. Since the receiving means is arranged near [which was established in the four corners of vehicles] the suspension system, the relative deflection between two or more positions detected with each receiving means can be secured to the maximum, and a vehicles posture can be detected correctly.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the way, although it became possible to perform engine control, brake control, steering control, etc. still more finely when the vehicles posture (a helix angle, a roll angle, yaw angle) was correctly detectable, conventional GPS or a conventional inertial navigation system was not able to detect a vehicles posture, although detection of a vehicles position was possible.
[0004] this invention was made in view of the above-mentioned situation, and aims at enabling it to detect a vehicles posture correctly by receiving and processing the position data from a satellite with two or more receiving meanses.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to attain the aforementioned purpose, invention indicated by the claim 1 Two or more receiving meanses by which it is arranged at a time near [at least one] the anterior part suspension system of vehicles, and the posterior part suspension system, and each receives the position data from two or more satellites, It is characterized by having a position detection means to detect the position of this receiving means based on the position data received with each receiving means, and a posture detection means to detect the posture of vehicles based on the position of each receiving means detected with the position detection means.
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[Embodiments of the Invention] Hereafter, it explains based on the example of this invention which showed the gestalt of operation of this invention to the accompanying drawing.
[0008] Operation explanatory drawing in case operation explanatory drawing in case the block diagram in which drawing 1 - drawing 5 show one example of this invention, and drawing 1 shows the whole posture detection equipment composition for vehicles, drawing in which drawing 2 shows the attaching position of a GPS antenna, and drawing 3 detect the helix angle of vehicles, and drawing 4 detect the roll angle of vehicles, and drawing 5 are operation explanatory drawings in the case of detecting the yaw angle and vehicles position of vehicles.
[0009] As shown in drawing 1 , four GPS antennas AFL, AFR, ARL, and ARR which constitute the receiving means of this invention are carried in vehicles, and each GPS antennas AFL, AFR, ARL, and ARR are two or more GPS satellites S1, S2, and S3. The position data from -- are received. A position detection means M1 by which the signal received with each GPS antennas AFL, AFR, ARL, and ARR is inputted computes the position of each GPS antenna AFL, AFR, ARL, and ARR by the 3-dimensional absolute coordinate system (for example, WGS84) of X, Y, and Z. The GPS satellite S1, S2, and S3 The position detection error is suppressed by about several cm to -- and the GPS antennas AFL, AFR, ARL, and ARR and the position detection means M1 constituting K-GPS (kinematic global positioning system) or RTK-GPS (real-time kinematic global positioning system), and the position detection error of the conventional GPS being about dozens of m.
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detects the position of the center section of vehicles while computing the helix angle of vehicles, a roll angle, and a yaw angle based on the aforementioned position coordinate. The concrete technique is explained later. And while the helix angle of the vehicles detected in the posture detection means M2, a roll angle, and a yaw angle are inputted into the vehicles control means M3 and used for engine control, brake control, steering control, etc., the position of the vehicles detected in the posture detection means M2 is inputted into a navigation system M4, and is used for pinpointing of a vehicles position.

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[0012] In addition, in accordance with the direction of east and west, as for the 3-dimensional absolute coordinate system used by this example, the Z-axis of the X-axis shall correspond [the Y-axis] in the perpendicular direction in accordance with the direction of north and south.

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[0014] As shown in drawing 3 , it is helix-angle thetaP of Vehicles V. The position coordinate detected with the GPS antennas AFL and ARL of a left-hand side order couple is used for calculation. Namely, if the position coordinate of the forward left GPS antenna AFL is set to (XFL, YFL, ZFL) and the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL) Horizontal distance DP between both the GPS antennas AFL and ARL DP = {(XFL-XRL)2+(YFL-YRL) 2} It is given by one half and is the distance HP of the vertical direction between both the GPS antennas AFL and ARL. It is given by HP =ZFL-ZRL. Therefore, helix-angle thetaP of Vehicles V thetaP = tan-1 (H.P./DP)

It is alike and is computed more.

[0015] Instead of using the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple like the above-mentioned example, in addition, one position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior, One position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior may be used, and the average of the position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior and the average of the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior may be used. Moreover, when there is a difference in the mounting height of the GPS antennas AFL and AFR of an anterior, and the mounting height of the GPS antennas ARL and ARR of a posterior, according to the difference of the mounting height, there is amendment need about Z component of a position coordinate.

[0016] Next, roll angle thetaR of the vehicles V performed in the aforementioned posture detection means M2 Calculation is explained.

[0017] As shown in drawing 4 , it is roll angle thetaR of Vehicles V. The position coordinate detected with the GPS antennas ARL and ARR of the right-and-left couple of a posterior is used for calculation. Namely, if the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL) and the position coordinate of the right rear GPS antenna ARR is set to (XRR, YRR, ZRR) Horizontal distance DR between both the GPS antennas ARL and ARR DR = {(XRL-XRR)2+(YRL-YRR) 2} It is given by one half and is the distance HR of the vertical direction between both the GPS antennas ARL and ARR. It is given by HR =ZRL-ZRR. Therefore, roll angle thetaR of Vehicles V thetaR = tan-1 (HR/DR)

It is alike and is computed more.

[0018] Instead of using the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior like the above-mentioned example, in addition, one position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple, One position coordinate of the GPS antennas

AFR and ARR of a right-hand side order couple may be used, and the average of the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple and the average of the position coordinate of the GPS antennas AFR and ARR of a right-hand side order couple may be used.
[0019] Next, yaw angle thetaY of the vehicles V performed in the aforementioned posture detection means M2 Calculation is explained.
[0020] As shown in drawing 5 , it is yaw angle thetaY of Vehicles V. The position coordinate detected with the GPS antennas AFL and ARL of a left-hand side order couple is used for calculation. That is, if the position coordinate of the forward left GPS antenna AFL is set to (XFL, YFL, ZFL) and the position coordinate of the left rear GPS antenna ARL is set to (XRL, YRL, ZRL), the distance DY1 of the direction of east and west between both the GPS antennas AFL and ARL will be given by DY1=XFL-XRL, and the distance DY2 of the direction of north and south between both the GPS antennas AFL and ARL will be given by DY2=YFL-YRL. Therefore, yaw angle thetaY of the vehicles V on the basis of the direction of north thetaY = tan-1 (DY1/DY2)
It is alike and is computed more.
[0021] In addition, instead of using the position coordinate of the GPS antennas AFL and ARL of a left-hand side order couple like the above-mentioned example, the position coordinate of the GPS antennas AFR and ARR of a right-hand side order couple may be used, and the position coordinate of the GPS antennas AFL and AFR of the right-and-left couple of an anterior and the position coordinate of the GPS antennas ARL and ARR of the right-and-left couple of a posterior may be used. In addition, if the distance from the body center line L differs with the GPS antennas AFL and AFR of the right-and-left couple of an anterior, and the GPS antennas ARL and ARR of the right-and-left couple of a posterior, according to the difference of the aforementioned distance, there is amendment need about detected yaw angle thetaY.
[0022] Moreover, in addition to calculation of the posture of the vehicles V mentioned above, the aforementioned posture detection means M2 also performs calculation of the position of Vehicles V.
[0023] In drawing 5 , if the position coordinate of four GPS antennas AFL, AFR, ARL, and ARR is set to (XFR, YFR, ZFR), (XRL, YRL, ZRL), and (XRR, YRR, ZRR), respectively (XFL, YFL, ZFL), the position coordinate (Xc, Yc, Zc) of the body center section C will be given by Xc=(XFL+XFR+XRL+XRR)/4Yc=(YFL+YFR+YRL+YRR)/4Zc= (ZFL+ZFR+ZRL+ZRR) / 4. In addition, it is also possible to compute the position coordinate (Xc, Yc, Zc) of the body center section C as the average of any two or more position coordinates in the position coordinate of four GPS antennas AFL, AFR, ARL, and ARR.
[0024] Thus, since the GPS antennas AFL, AFR, ARL, and ARR were formed, respectively near the suspension system of the wheels WFL, WFR, WRL, and WRR arranged in the four corners of Vehicles V Big relative deflection can be generated between the positions of each GPS antennas AFL, AFR, ARL, and ARR with posture change of Vehicles V, and, thereby, they are helix-angle thetaP of Vehicles V, and roll angle thetaR. And yaw angle thetaY It is correctly detectable.
[0025] Moreover, since it becomes possible to pinpoint the position of Vehicles V much more precisely by computing the position coordinate of the body center section C, it becomes possible to distinguish whether Vehicles V are running which lane of a passage, or to distinguish whether it is running the passage of the bottom whether Vehicles V are running the elevated passage. Moreover, when a passage configuration cannot be acquired with aerial photograph etc., it becomes possible by actually running the passage and detecting move tracing of the body center section C to acquire an exact passage configuration.
[0026] As mentioned above, although the example of this invention was explained in full detail, this invention can perform design changes various in the range which does not deviate from the summary.
[0027] For example, although the GPS antennas AFL, AFR, ARL, and ARR are formed near the suspension system of each wheels WFL, WFR, WRL, and WRR in the example, respectively If at least one GPS antenna is formed near the suspension system of the front wheels WFL and WFR on either side and at least one GPS antenna is formed near the suspension system of the rear wheels WRL and WRR on either side Helix-angle thetaP of Vehicles V, and roll angle thetaR And yaw angle thetaY It is detectable.

However, roll angle thetaR Since it is necessary to shift and arrange the GPS antenna of an anterior and a posterior to the cross direction in order to detect, it is appropriate to form a GPS antenna, respectively near the suspension system of the forward left ring WFL and the right rear ring WRR, or to form a GPS antenna, respectively near the suspension system of the forward right ring WFR and the left rear ring WRL.

[Translation done.]

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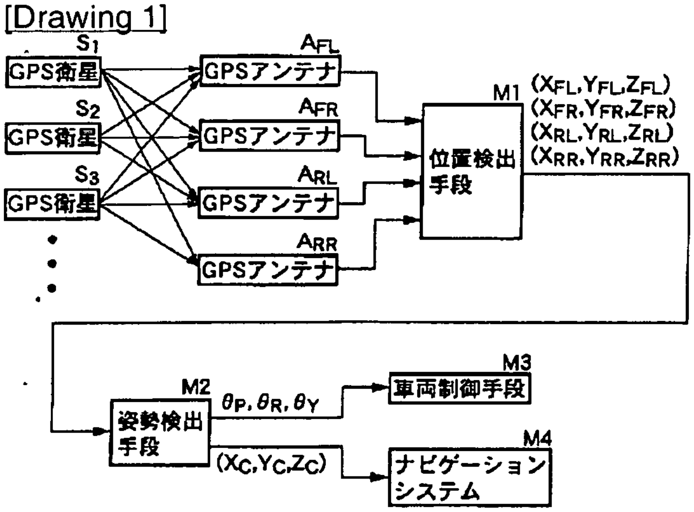
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram showing the whole posture detection equipment composition for vehicles
[Drawing 2] Drawing showing the attaching position of a GPS antenna
[Drawing 3] Operation explanatory drawing in the case of detecting the helix angle of vehicles
[Drawing 4] Operation explanatory drawing in the case of detecting the roll angle of vehicles
[Drawing 5] Operation explanatory drawing in the case of detecting the yaw angle and vehicles position of vehicles
[Description of Notations]
M1 Position detection means
M2 Posture detection means
AFL, AFR, ARL, ARR GPS antenna (receiving means)
S1, S2, and S3 -- Satellite
V Vehicles

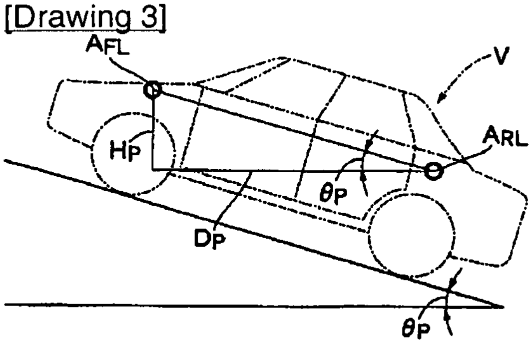
[Translation done.]

DRAWINGS

[Drawing 1]

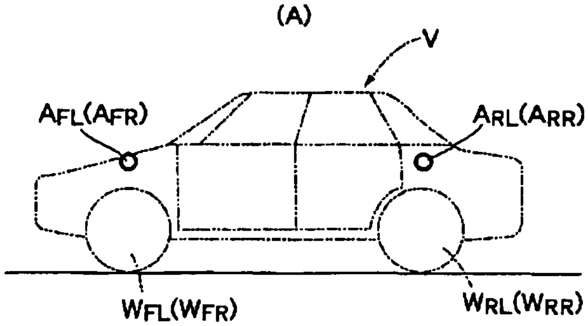


[Drawing 3]



[Drawing 2]

(A)



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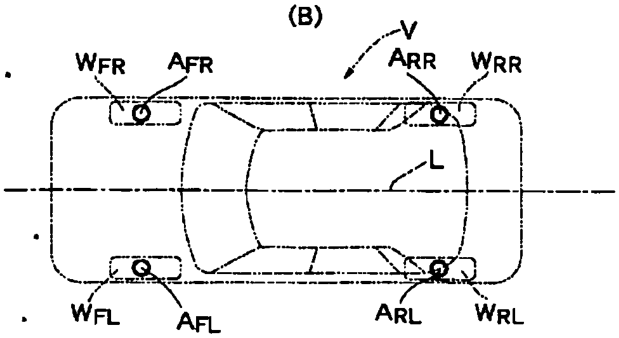
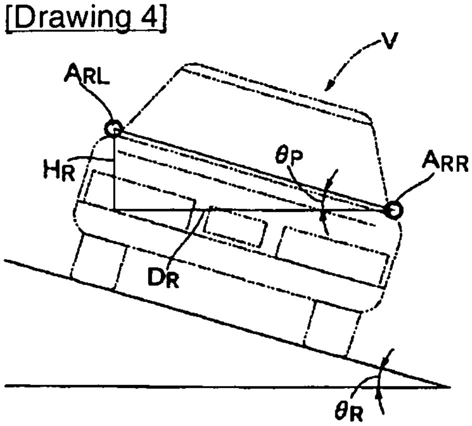
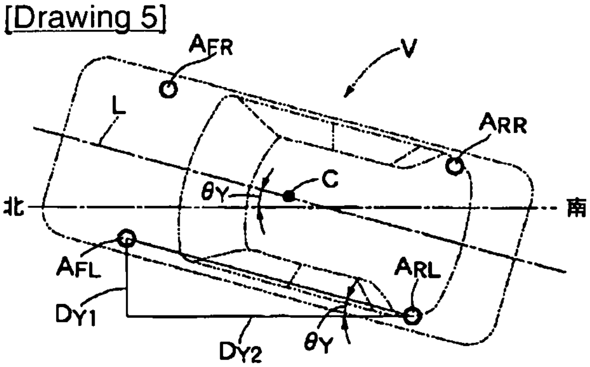


[Drawing 4]



[Drawing 5]



[Translation done.]